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What Factors Determine the Use of an Electronic Test Result Acknowledgement System? - A Qualitative Study Across Two EDs

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Abstract. Electronic medical record-based test results management interventions hold the potential to reduce errors in the test result follow-up process**.** However, ensuring the adaptability of such systems to the clinical environment has proven challenging. The aim of this study was to explore how contextual factors can influence senior emergency physicians' experience and perceived impacts of an electronic result acknowledgement system across two Emergency Departments. Semi-structured, in-depth interviews relating to physician test result acknowledgement processes before and after system implementation were conducted with 14 senior Emergency Physicians across two Australian metropolitan teaching hospitals. Perceived impacts of the electronic test result acknowledgement system on test result endorsement varied in terms of: changes to workflow, impacts on patient safety; and changes to documentation practices. Existing work practices and the departmental staffing mix and roles play a part in determining the nature of change that an electronic result acknowledgement system is likely to produce.

Keywords. Missed test results, electronic result acknowledgement, eMR, qualitative studies, patient safety, workflow

Introduction

Failure to follow up diagnostic test results is an area of concern across healthcare systems internationally [1]. The rate of missed test results vary from 1% to 75% for ambulatory patients and from 20% to 62% for hospitalised patients [2, 3], with impacts ranging from inappropriate antibiotic prescription to missed cancer diagnoses and death [3]. Electronic medical record (eMR)-based test results management interventions hold the potential to reduce errors by means of tracking pending test results at discharge [4], electronic alerting of test results upon availability [5], and documentation of test acknowledgement and subsequent clinical action [6]. However, unintended errors may result when systems cause significant deviation or reengineering of existing patterns of work and behaviour [7], and ensuring the adaptability of such systems to the clinical

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environment has proven challenging in their design, development, and implementation [8].

There is an expanding body of literature on the impact of electronic test result management interventions on the safety and quality of test result follow up [9, 10]. However, while these studies provide valuable guidance for how electronic systems may work successfully, they do not always inform us of the contextual factors which can determine or influence outcomes of system implementation. Yet, context is a key factor to understanding what works, when and how. This study aimed to explore the role of contextual factors in influencing senior emergency physicians' experience and perceived impacts of an electronic results acknowledgement (eRA) system across two demographically discordant Emergency Departments (EDs).

1. Methods

1.1. Design, Setting and Sample

A cross-sectional qualitative study involving in-depth interviews was conducted to explore physicians' test management work processes after implementation of an on-line test result acknowledgement system within the existing eMR. The study was conducted in two EDs of two Sydney metropolitan teaching hospitals, selected based on their use of the test result acknowledgement system. Emergency physicians with formal result acknowledgement duties were included in the study sample. Participants were selected purposively based on their use and familiarity with the electronic test result acknowledgement system. This resulted in fourteen interviews from an eligible population of sixteen senior emergency physicians (n=2 at Site 1; n=12/14 at Site 2) conducted across both sites from December 2013 to April 2014.

1.2. Intervention

The Cerner Millennium Message Centre is an electronic inpatient and outpatient workflow management module comprising an Inbox containing documents and notifications requiring review, attention, or signature, including test result reports. Results of all microbiology and radiology tests ordered from the ED arrive electronically in the Inbox, and can be viewed by all authorised ED physicians through their personal account. Use of the Message Centre for eRA commenced across the study sites during August/September 2013.

1.3. Data Collection and Analysis

Semi-structured, in-depth interviews relating to physician test result acknowledgement processes before and after module implementation were conducted by two researchers (JL, JC) across sites. Selective participants were re-interviewed to further explore queries or gaps which had arisen in their data and to shed light on emerging themes during analysis. Notes taken from a discussion with ED physicians at both sites who had acknowledgement responsibilities prior to the formal data collection period were analysed to provide context and inform interview questions. All interviews were recorded and subsequently transcribed to allow for qualitative analysis using a thematic

grounded theory approach. Categories were derived from line coding and triangulated between two researchers (JL, JC).

2. Results

Participants at both sites described their results acknowledgement work processes before and after eRA implementation. The advent of the eRA at Site 1 entailed a significant change in work practices. However, the results acknowledgement process post-system implementation at Site 2 closely mirrored the manual process that existed before system implementation. Interviews revealed three major themes in relation to the perceived impact of the electronic test result acknowledgement implementation comprising: changes to workflow; the effects on patient safety; and changes to documentation practices.

2.1. Results Acknowledgement Workflow

Perceptions of changes to efficiency and volume of work differed between the sites, mainly due to different results acknowledgement work processes that existed before the implementation of the electronic test result acknowledgement system. A perception of increased workload was reported at Site 1, where implementation of the system was associated with a major change in how and which tests were acknowledged. Prior to system implementation, manual results acknowledgement was completed by the ED Director and Deputy on an ad-hoc basis when and only for reports of *abnormal results* faxed or rung through to the ED from ancillary departments.

Following eRA system implementation, all radiology and microbiology test results ordered from the ED were required to be acknowledged electronically. This necessitated an extra hour per day of results acknowledgement if results were *normal*, and additional time for *abnormal* results requiring additional investigation or follow up action. The Director and Deputy Director each scheduled results acknowledgement sessions on alternating days, and reported that the process was "resource intensive" at their hospital where a shortage of permanent senior ED physicians (as opposed to locums) meant that there was no other staff available to share the workload ("we've very limited staff here with office time allocated to doing tasks…it's a massive increase from what we were doing" Dr 1, Site 1). Both physicians at this site emphasised the need for demarcation, or "flagging" of abnormal results to allow prioritisation of abnormal results acknowledgement, and swift acknowledgement of normal results without the need to review entire reports.

In contrast, the majority of participants at Site 2 felt that the eRA process was noticeably faster than their previous manual process of acknowledgement ("it's just quicker, it is definitely quicker" Dr 5, Site 2). The eRA process mirrored the manual result acknowledgement process previously practised at this site, but eliminated the time spent negotiating paper-related tasks such as collecting paper reports that were printed or sent to the department, delivering acknowledged reports to a designated location for filing, and delays in the arrival of results due to printer paper jams, empty printing trays and printer malfunctions.

Access to patient information for cases of abnormal results requiring further investigation was also perceived to be easier and quicker through the eRA system. Electronic result reports are linked to the associated electronic patient medical record

which meant that there was no need to search for a particular record to consult clinical notes. Follow-up actions taken on previous results that were documented on the paper report, or in the paper medical record were now available in the eMR, and were easily accessed and viewed without the need to request paper records from the Medical Records Department. Similarly, there was also no need to request paper records for documentation of follow-up actions in the progress notes.

Respondents at Site 2 reported that results became viewable as soon as they were electronically published by the pathology and radiology departments in real time. Previously, physicians were required to wait for a staff member from those departments to print out hard copy result reports and fax them to the ED.

2.2. Patient Safety

Respondents at both sites expressed generally positive views regarding the impact of eRA on patient safety. Physicians at Site 1 conceded an increased workload, but also increased confidence that they were now reviewing all abnormal results, rather than select reports deemed clinically significant by the radiologist/pathologist ("I wasn't in control of what was coming to me…[now] I'm more certain that I'm getting access to abnormal results" Dr 1, Site 1). The acknowledgement process post eRA system implementation became a formal, regular process which physicians deemed safer than the manual process which occurred only for results that were rung or faxed through at the discretion of the radiologist/pathologist.

Electronic time stamping of radiology result reports upon arrival in the Message Centre inbox rendered radiology reporting times more transparent, and Site 1 physicians felt that this improved radiology result turnaround times. Respondents at Site 2 ascribed a perceived improved turnaround time for all results to a more direct result transmission process from the ancillary departments to the ED which precluded a member from those departments printing out hard copy result reports to fax to the ED.

Participants from Site 2 expressed that receiving, reviewing and acknowledging results electronically precluded the possibility of lost paper reports, sticky-notes, and other informal, paper-based methods previously employed to communicate reminders and hand over incomplete acknowledgements between shifts and physicians. A noticeably faster eRA process than its manual counterpart reduced result backlogs, and led to the earlier detection of clinically significant abnormal findings. Site 2 physicians found that they could commence relevant therapeutic interventions while patients were still in the ED, and time to follow-up of patients already discharged was perceived to have decreased from up to a week to a couple of days ("it always used to be four or five days versus one or two days [now]" Dr 2, Site 2).

Further, a legible date and time-stamped electronic signature improved accountability in cases of error such as missed/wrongly endorsed results and led to more comprehensive documentation. Physicians resuming care on a patient could also easily identify physicians who had acted on previous results if further information was required during subsequent results reviews ("it used to be that people wouldn't be able to read someone's signature…Whereas now…you can easily catch up with that person and say you didn't do this or you didn't do that; it's all there" Dr 5, Site 2).

2.3. Documentation of Result Acknowledgement

Physicians at Site 2 reported improved consistency in the location of follow-up action documentation following the implementation of the eRA system. The reminder functionality which appears as a "Comments" field on the same page as electronic result reports allows physicians to document all comments or follow-up actions which then subsequently appear in the Results Flowsheet in a patient's eMR. Notes regarding follow-up were previously recorded in a variety of locations (paper medical record, paper result report, addendum in the electronic discharge summary, or Case History note in the eMR). Physicians at Site 2 reported that with the new eRA system it was now noticeably quicker and easier to review previous follow up actions taken by colleagues in the patient's eMR, than to search for notes which may or may not exist across a variety of mediums (paper vs electronic) and locations (eMR in office vs the medical record department).

3. Discussion

The social implications of electronic result management interventions are well explored in the literature [11, 12]. This study aimed to explore the contextual characteristics of a clinical setting which can influence the organisational response and perceived impact of the health IT intervention. Findings from our study sites revealed that the nature of existing test acknowledgement processes resulted in different perceptions of the impact of eRA on workflow by senior emergency physicians. Site 1 respondents found that the eRA system resulted in the re-engineering of their existing, manual results acknowledgement process. Further, the labour requirements of the eRA system could not be supported by the existing staff mix of the department which lacked the permanent senior emergency physicians required to undertake a daily systematic results acknowledgement procedure.

The impact of the same system on test acknowledgement workflow was less disruptive at Site 2 where the eRA process mirrored the previous manual process. Work process variations between sites prior to eRA system implementation also saw the system deliver different perceived patient safety benefits. In addition, the introduction of the eRA system appeared to have standardised the results acknowledgement work process across sites.

Errors in test result follow up in EHR-enabled health systems are well documented [13, 14]. However, there is an under emphasis on the contextual factors which influence both test result management and organisational impacts of health information technology. New information systems within healthcare environments do not work simply because they have been constructed to do so. Systems are designed to enable people to make them work, and people may choose not to make them work, or they may find the conditions not conducive to doing so. There is a complex range of contextual factors and triggers that will play their role [15]. A study by Menon and colleagues [16] concluded that context-related vulnerabilities could predispose clinicians or organisations to missed test results in EHR-based settings, and interventions to reduce missed test results should recognise and target organisational factors.

Contexts differ both between and within hospitals, and test result follow-up processes can vary widely between sites, even when the sites share a common EHR

[17]. An outcome of the eRA system observed in our study is the degree of standardisation of results acknowledgement work practices following eRA system implementation across the two sites. Whilst participants across sites responded differently to the new work process, all participants conceded that the eRA process would likely lead to improved patient safety. eRA systems can play a role in facilitating a higher level of workflow standardisation across hospitals and eliminate potentially problematic context-specific processes which compromise the safety of test result follow-up [13, 16].

This study employed qualitative research methods to gain a rich understanding of the user response to the introduction of an eMR-based eRA system. The selection of two different EDs using an identical eRA system helped to identify the role and impact of contextual factors in the uptake and sustainability of eRA systems. The highly context-sensitive findings from this study are limited in their generalisability to other sites, but provide insight into how outcomes of health IT may differ across clinical settings.

4. Conclusion

Exploring the role of context on implementation outcomes adds a new perspective to understanding the impacts of an eRA system. There is a dynamic interaction between systems and the clinical settings in which the health IT systems are intended to be used. Understanding the factors that shape this interaction is important in ensuring the systems are used in efficient and effective ways that contribute to quality patient care.

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